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Branham

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(54) **VERMICOMPOSTING DEVICE**

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(73) Assignee: **Frontier Paper & Packaging, Inc.**, Indianapolis, IN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 804 days.

(21) Appl. No.: **13/082,707**

(22) Filed: **Apr. 8, 2011**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
C12M 1/14 (2006.01)
C05F 17/00 (2006.01)
C05F 17/02 (2006.01)

(52) **U.S. Cl.**
CPC ***C05F 17/0009*** (2013.01); ***C05F 17/0205*** (2013.01)

(58) **Field of Classification Search**
CPC C05F 17/0205; C05F 17/0252; C05F 17/0009; C05F 17/0211; C05F 17/02; B65F 1/00; B65F 2001/1489; A01K 67/0332
USPC 435/290.1, 290.3, 290.4; 206/507; 119/6.7
See application file for complete search history.

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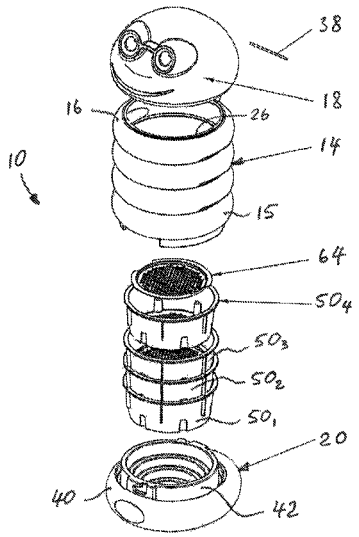
(57) **ABSTRACT**

A vermicomposting device for vermicomposting organic material, comprises a casing including an annular hollow body member defining an internal cavity, a head member mounted to an upper end portion of the body member and a base member removably attached to a lower end portion of the body member, and a plurality of composting trays removably disposed within the internal cavity in a stacked relationship. Each of the composting trays is an open top tray including a circular perforated bottom wall surrounded by an annular side wall upwardly extending from the perforated bottom wall. The base member includes a support portion and a drip bucket disposed under the composting trays to receive and collect any liquid byproduct from the vermicomposting process. The head member is movable relative to the body member so as to provide an access to the internal cavity of the body member.

20 Claims, 12 Drawing Sheets



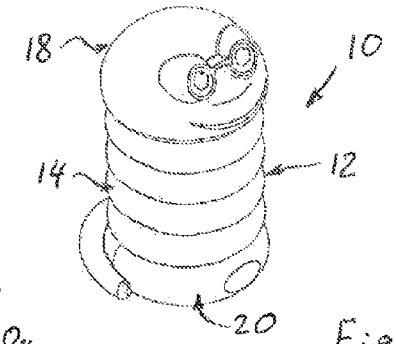


Fig. 1

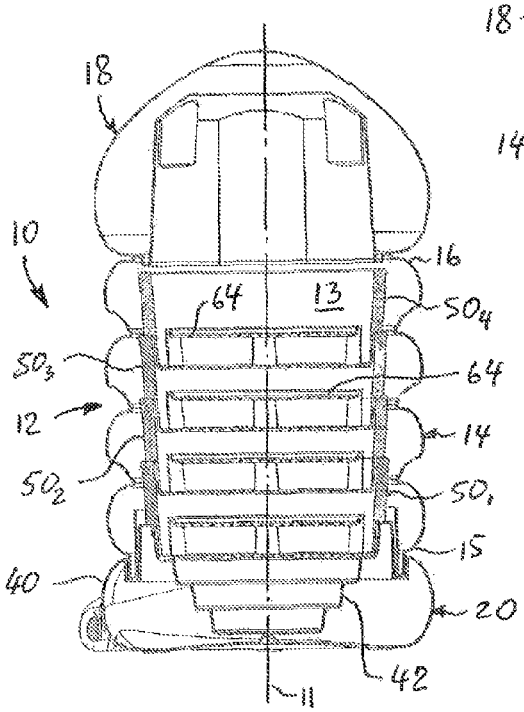


Fig. 3

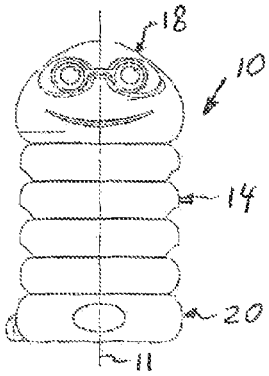


Fig. 2C

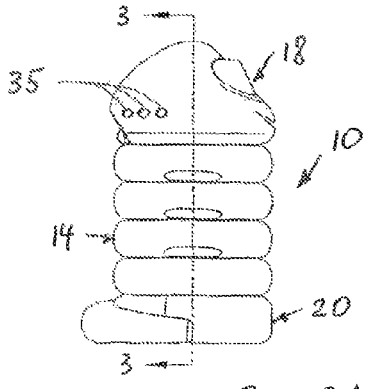


Fig. 2A

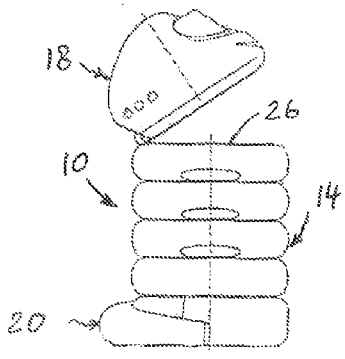


Fig. 2B

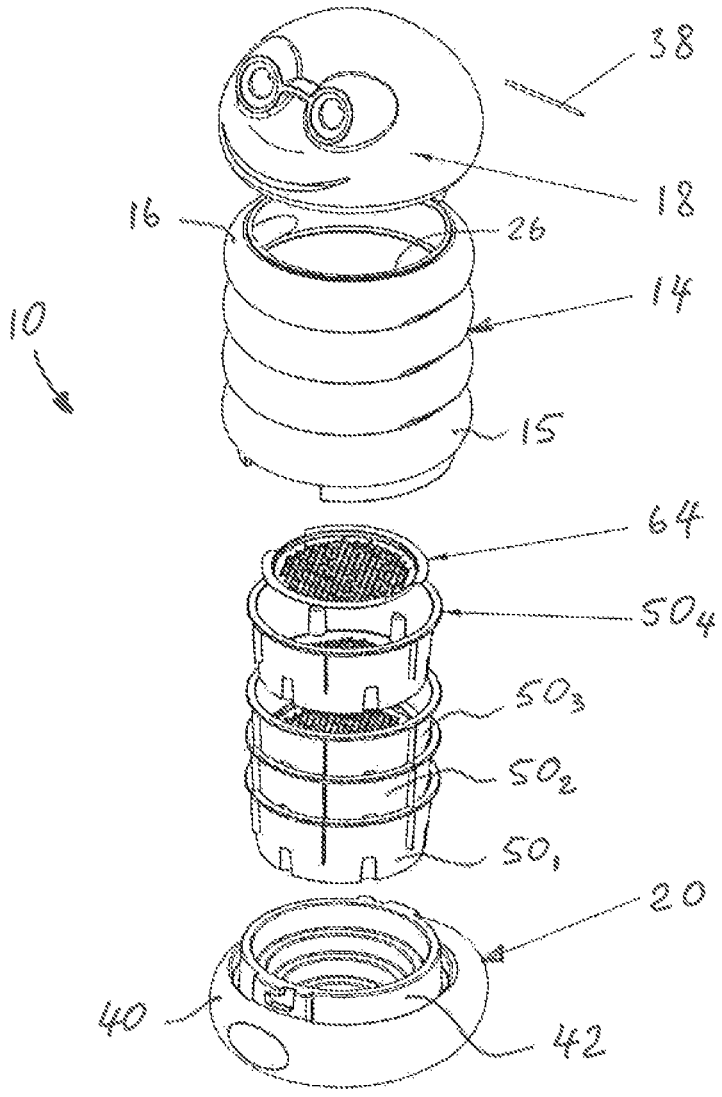


Fig. 4

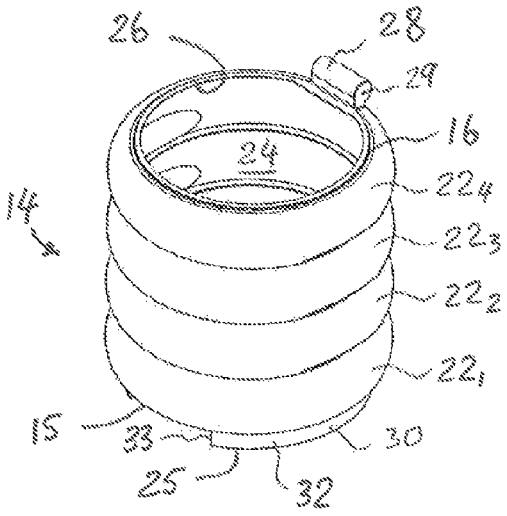


Fig. 5

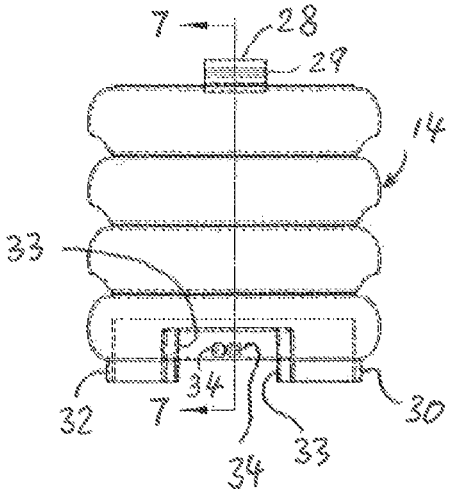


Fig. 6

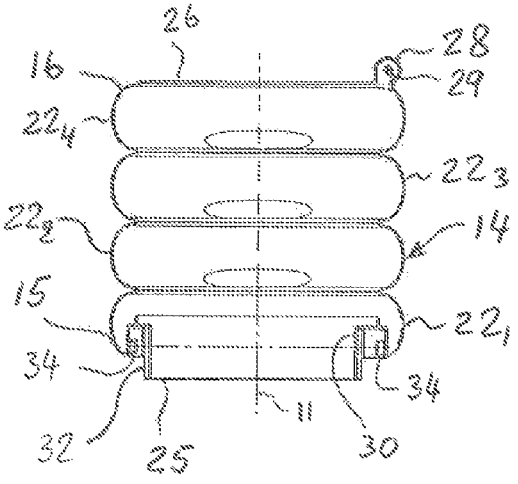


Fig. 7

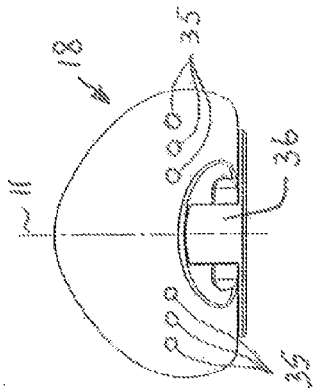


Fig. 9C

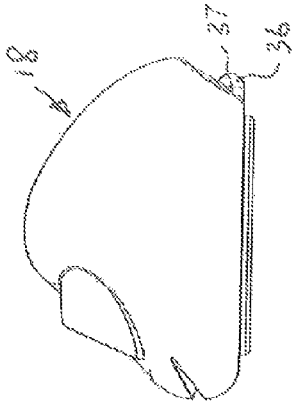


Fig. 9B

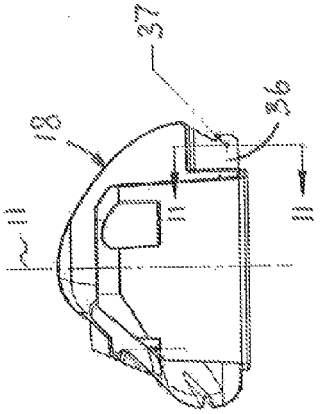


Fig. 10

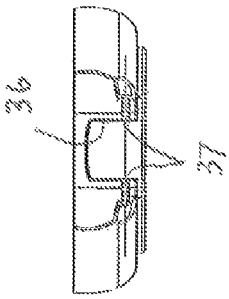


Fig. 11

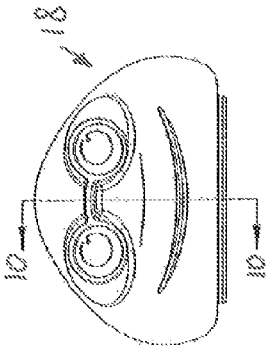
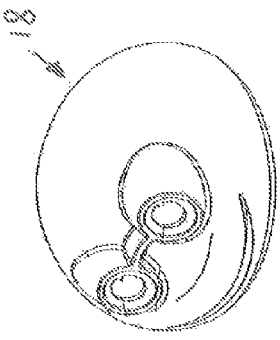


Fig. 9A



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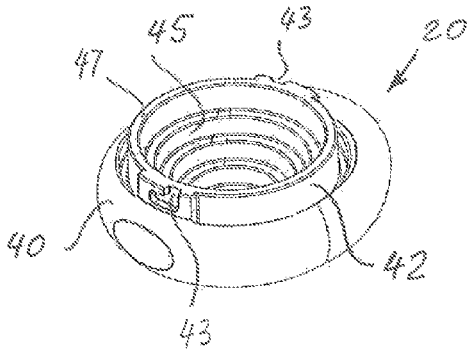


Fig. 12

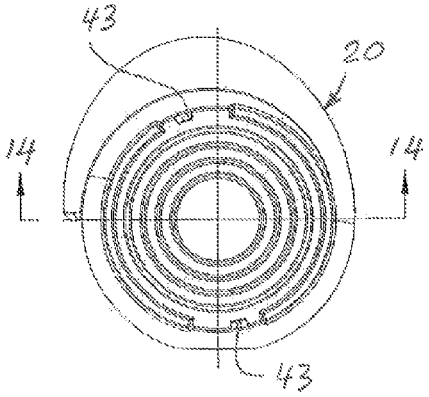


Fig. 13A

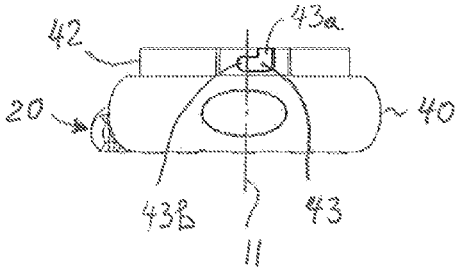


Fig. 13B

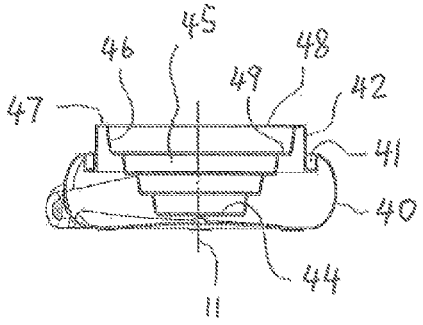


Fig. 14

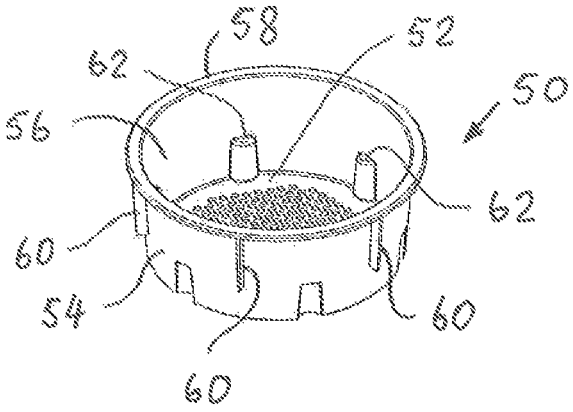


Fig. 15

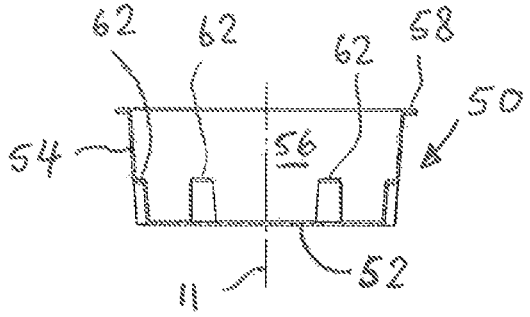


Fig. 17

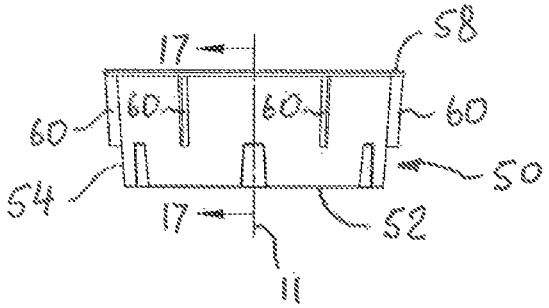
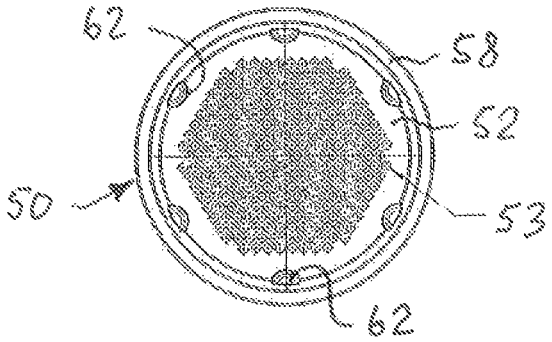


Fig. 16A



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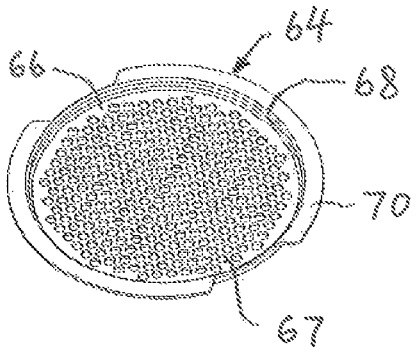


Fig. 18

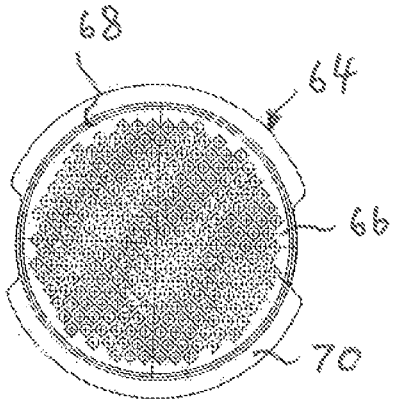


Fig. 19A

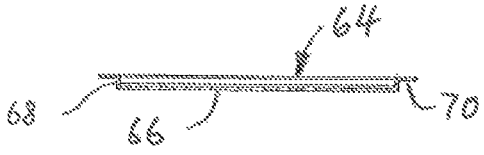


Fig. 20

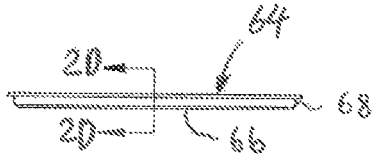


Fig. 19B

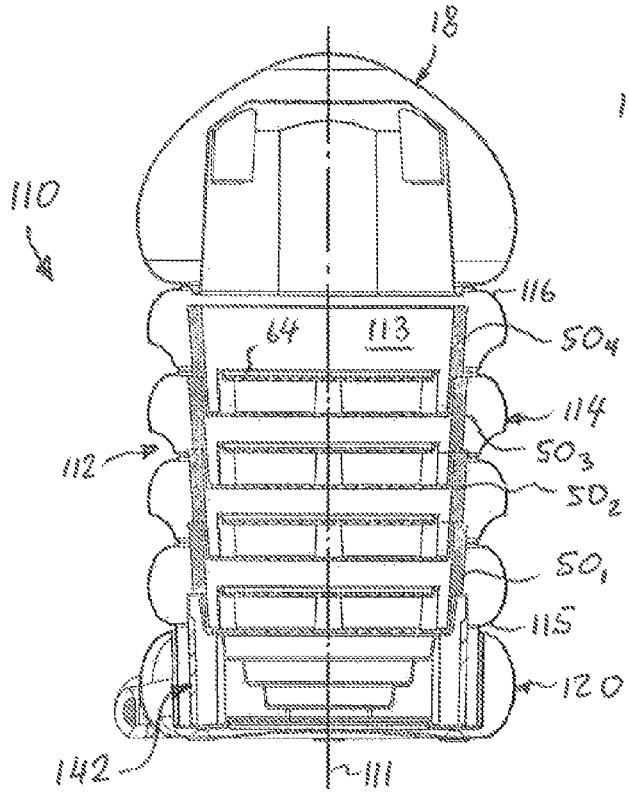


Fig. 23

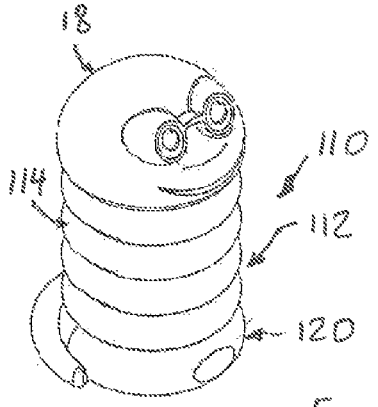


Fig. 21

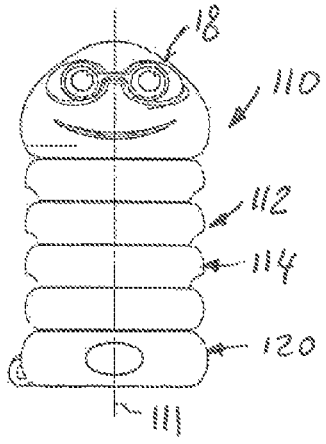


Fig. 22B

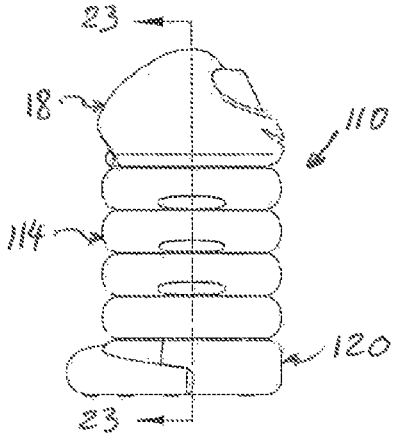


Fig. 22A

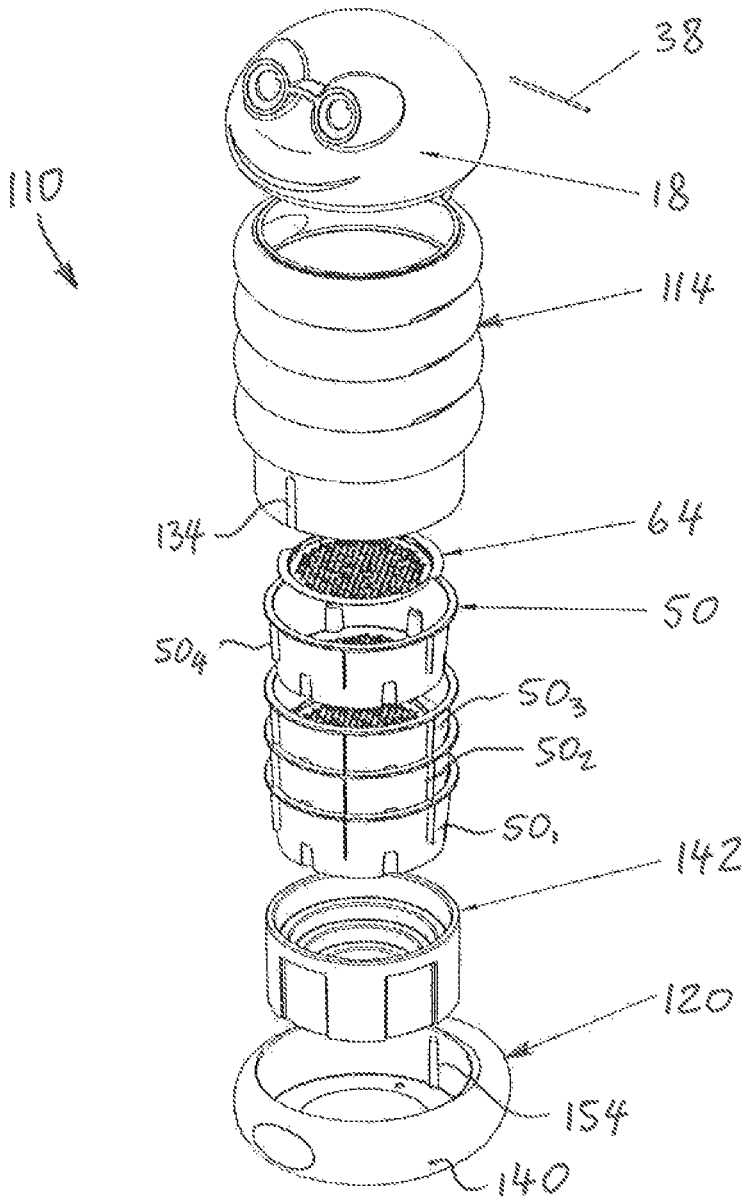


Fig. 24

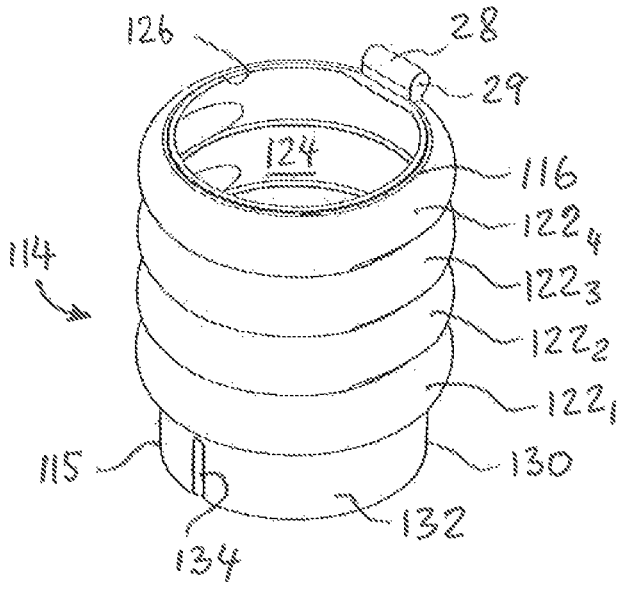


Fig. 25

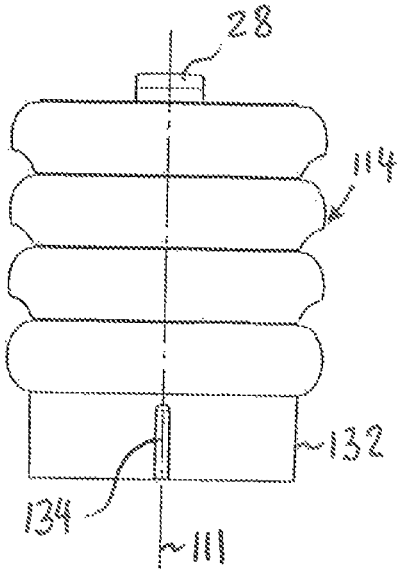


Fig. 26

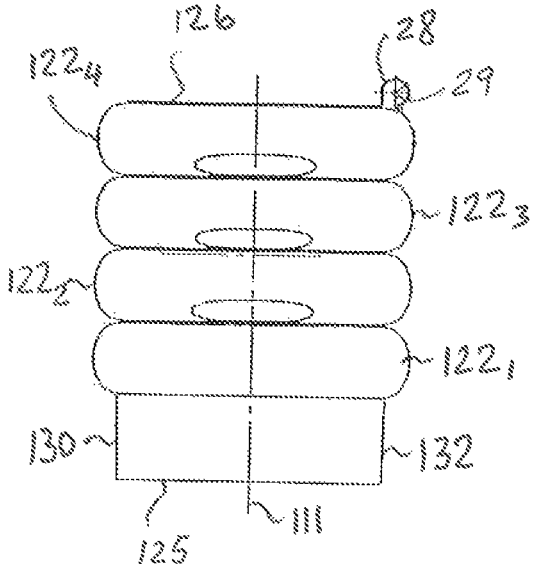
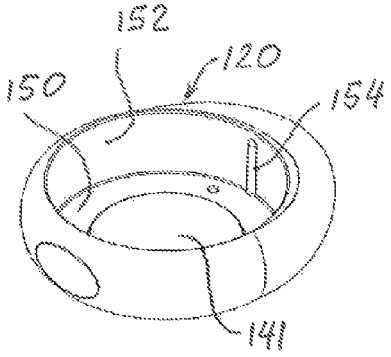


Fig. 27



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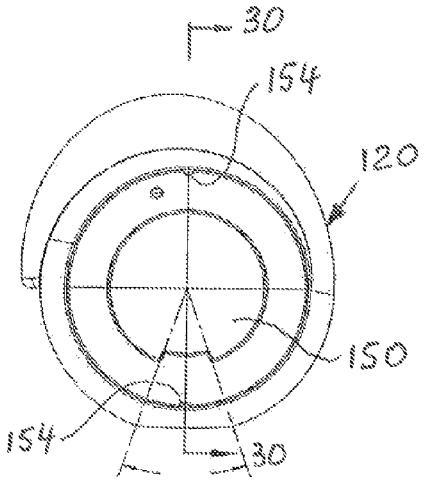

Fig. 29A

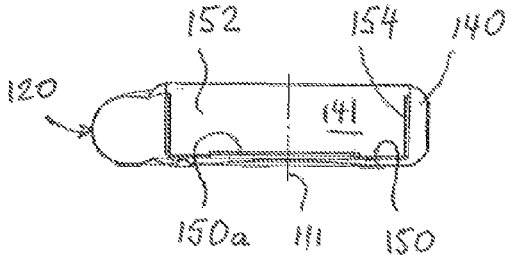

Fig. 30

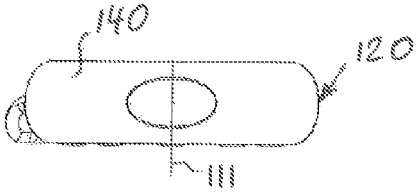

Fig. 29B

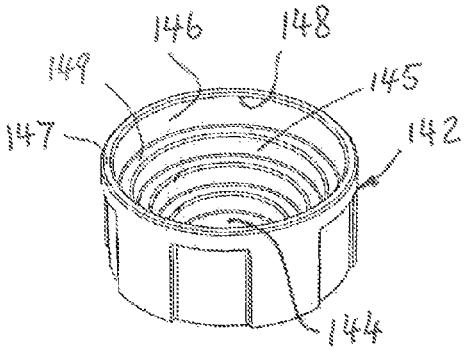

Fig. 31

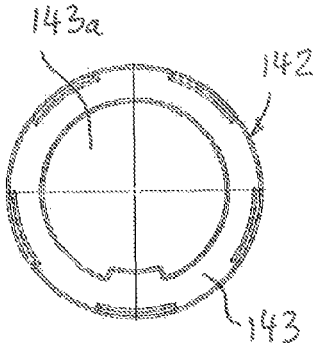

Fig. 32A

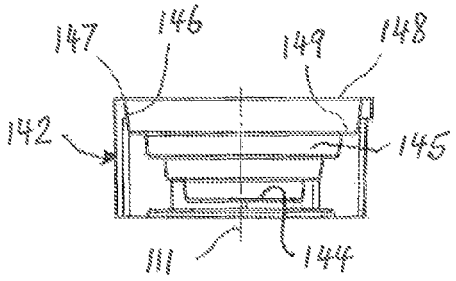

Fig. 33

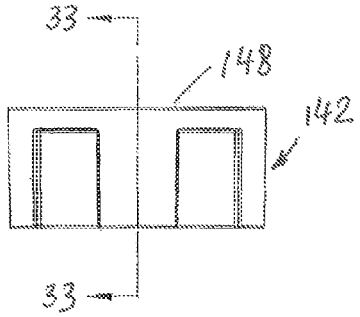

Fig. 32B

VERMICOMPOSTING DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

This Application claims the benefit under 35 U.S.C. 119(e) of U.S. Provisional Patent Application Ser. No. 61/454,816 filed Mar. 21, 2011 by Branham, J., which is hereby incorporated herein by reference in its entirety and to which priority is claimed.

BACKGROUND OF INVENTION

1. Field of the Invention

This invention relates to composting devices for vermicomposting of organic waste material in general, and, more particularly, to a vermicomposting device that receives organic waste material to produce compost using worms to break down organic waste material.

2. Description of the Prior Art

The process of vermicomposting or transforming organic waste materials into natural fertilizers and/or soil additives with the use of worms is well-known to those skilled in the art. Vermicomposting process uses worms to recycle food scraps and other organic material, especially vegetable household waste and light garden waste, into a valuable soil amendment called vermicompost, or worm compost. Worms consume, digest and absorb largely organic matter, such as food scraps, which become compost as they pass through the worm's body. Compost exits the worm through its tail end. This compost can then be used to grow plants. In other words, the worms are eating nutrient-rich fruit and vegetable scraps, and turning them into nutrient-rich compost.

In order for the vermicomposting process to provide optimal results, certain conditions must exist. For example, the micro-organisms and worms, which decompose the organic waste material require an environment with adequate amounts of air, water, and nutrients to support metabolic activity. In the case of aerobic composting, the ambient air is the primary source of oxygen. Thus, the circulation of ambient air within the compost pile must be sufficient to meet the metabolic requirements of the microbes as well as to disperse the waste gases including methane gas, which is produced as a by-product of the process. Vermicomposting proceeds most efficiently within a certain temperature range as with the case of any chemical reaction. Vermicomposting is accelerated if the compost pile is insulated such that the heat generated by the decaying process is contained within the compost pile.

While known vermicomposting devices have proven to be acceptable for various gardening applications, such devices are nevertheless susceptible to improvements that may enhance their performance, applicability, cost and attractiveness. With this in mind, a need exists to develop improved vermicomposting device that advances the art.

SUMMARY OF THE INVENTION

The present invention is directed a vermicomposting device for vermicomposting of organic waste material.

The vermicomposting device according to the present invention comprises a casing extending along a central axis and including a substantially annular hollow body member defining an internal cavity and having a lower end portion and an upper end portion, a head member mounted to the upper end portion of the body member, and a base member removably attached to the lower end portion of the body member for supporting the vermicomposting apparatus on a support surface, and a plurality of composting trays removably disposed within the internal cavity in a stacked relationship in the direction of the central axis. Each of the composting trays is in the form of an open top tray that includes a circular perforated bottom wall surrounded by an annular side wall upwardly extending from the perforated bottom wall so as to form a cavity adapted to contain a composting material and/or ready to use compost and worms. The base member includes a support portion and a drip bucket mounted to the support portion and defines a container disposed under the composting trays to receive and collect any liquid byproduct from the vermicomposting process drained down into the drip tray through the perforated bottom wall of the composting trays. The drip bucket is in the form of an open top bucket that includes a circular solid bottom wall surrounded by an annular side wall upwardly extending from the bottom wall toward the composting trays. The head member is movable relative to the body member so as to provide an access to the internal cavity of the body member.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages and novel features will become apparent from the detailed description of the preferred embodiments of the invention illustrated in the accompanying drawings, wherein:

FIG. **1** is a perspective view of a vermicomposting device according to a first exemplary embodiment of the present invention;

FIG. **2**A is a side view of the vermicomposting device according to the first exemplary embodiment of the present invention with a head member in a closed position;

FIG. **2**B is a side view of the vermicomposting device according to the first exemplary embodiment of the present invention with the head member in an open position;

FIG. **2**C is a front view of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **3** is a vertical cross-sectional view of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **3**-**3** in FIG. **2**A;

FIG. **4** is an exploded perspective view of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **5** is a perspective view of a body member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **6** is a front view of the body member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **7** is a vertical cross-sectional view of the body member of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **7**-**7** in FIG. **6**;

FIG. **8** is a perspective view of a head member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **9**A is a front view of the head member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **9**B is a side view of the head member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **9**C is a backside view of the head member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **10** is a vertical cross-sectional view of the head member of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **10-10** in FIG. **9**A;

FIG. **11** is a vertical cross-sectional view of the head member of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **11-11** in FIG. **10**;

FIG. **12** is a perspective view of a base member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **13**A is a top view of the base member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **13**B is a side view of the base member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **14** is a vertical cross-sectional view of the base member of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **14-14** in FIG. **13**A;

FIG. **15** is a perspective view of a composting tray of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **16**A is a side view of the composting tray of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **16**B is a top view of the composting tray of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **17** is a vertical cross-sectional view of the composting tray of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **17-17** in FIG. **16**A;

FIG. **18** is a perspective view of a grid member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **19**A is a top view of the grid member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **19**B is a side view of the grid member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **20** is a vertical cross-sectional view of the grid member of the vermicomposting device according to the first exemplary embodiment of the present invention taken along the lines **20-20** in FIG. **19**B;

FIG. **21** is a perspective view of a vermicomposting device according to a second exemplary embodiment of the present invention;

FIG. **22**A is a side view of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **22**B is a front view of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **23** is a vertical cross-sectional view of the vermicomposting device according to the second exemplary embodiment of the present invention taken along the lines **3-3** in FIG. **2**A;

FIG. **24** is an exploded perspective view of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **25** is a perspective view of a body member of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **26** is a front view of the body member of the vermicomposting device according to the first exemplary embodiment of the present invention;

FIG. **27** is a side view of the body member of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **28** is a perspective view of a base member of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **29**A is a top view of the base member of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **29**B is a side view of the base member of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **30** is a vertical cross-sectional view of the base member of the vermicomposting device according to the second exemplary embodiment of the present invention taken along the lines **30-30** in FIG. **29**A;

FIG. **31** is a perspective view of a drip bucket of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **32**A is a top view of the drip bucket of the vermicomposting device according to the second exemplary embodiment of the present invention;

FIG. **32**B is a side view of the drip bucket of the vermicomposting device according to the second exemplary embodiment of the present invention; and

FIG. **33** is a vertical cross-sectional view of the drip bucket of the vermicomposting device according to the second exemplary embodiment of the present invention taken along the lines **33-33** in FIG. **32**B.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

The preferred exemplary embodiments of the present invention will now be described with the reference to the accompanying drawings.

For purposes of the following description, certain terminology is used in the following description for convenience only and is not limiting. The words such as "front" and "rear", "left" and "right", "top" and "bottom", "upper" and "lower", "inwardly" and "outwardly" designate directions in the drawings to which reference is made. The words "smaller" and "larger" refer to relative size of elements of the apparatus of the present invention and designated portions thereof. The terminology includes the words specifically mentioned above, derivatives thereof and words of similar import. Additionally, the word "a", as used in the claims, means "at least one".

Vermicompost is a product of composting utilizing various species of worms, specifically red wigglers, white worms, and earthworms creating the heterogeneous mixture of decomposing vegetable or food waste, bedding materials, and pure vermicast produced during the course of normal vermiculture operations. Vermicast, similarly known as worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by the species of earthworm. Containing water-soluble nutrients and bacteria, vermicompost is an excellent, nutrient-rich organic fertilizer and soil conditioner. The process of producing vermicompost is called vermicomposting.

The following description is presented to enable any person skilled in the art to make and use the invention. Descriptions of specific embodiments and applications are provided only as examples and various modifications will be readily

apparent to those skilled in the art. The general principles defined herein may be applied to other embodiments and applications without departing from the spirit and scope of the invention. Thus, the present invention is to be accorded the widest scope encompassing numerous alternatives, modifications and equivalents consistent with the principles and features disclosed herein. For purpose of clarity, details relating to technical material that is known in the technical fields related to the invention have not been described in detail so as not to unnecessarily obscure the present invention.

FIGS. **1-20** illustrate a vermicomposting device according to according to a first exemplary embodiment of the present invention, generally denoted by reference numeral **10**. As shown in FIGS. **1-4**, the vermicomposting device **10** comprises a hollow casing **12** extending along a central axis **11** and defining an internal cavity **13** therein. The casing **12** includes a substantially annular, hollow body member **14**, a head member **18** and a base member **20**. The body member **14** has a lower end portion **15** and an upper end portion **16**. Further according to the present invention, the head member **18** is pivotally mounted to the upper end portion **16** of the body member **14**, while the base member **20** is removably attached to the lower end portion **15** of the body member **14** for supporting the vermicomposting device **10** in an upright, vertical position on a support surface, such as ground of a backyard. The casing **12** of the vermicomposting device **10** according to the present invention is made in the shape of an animal including a worm, a bug, a reptile, a bird or a mammal. For the purpose of this invention, the term animal applies to any of a kingdom (Animalia) of living things including many-celled organisms and often many of the single-celled ones (as protozoans) that typically differ from plants in having cells without cellulose walls, in lacking chlorophyll and the capacity for photosynthesis, in requiring more complex food materials (as proteins), in being organized to a greater degree of complexity, and in having the capacity for spontaneous movement and rapid motor responses to stimulation. Preferably, as illustrated in FIGS. **1-4**, the casing **12** of the vermicomposting device **10** is made in the shape of a stylized earthworm in an upright position.

Each part of the casing **12**, i.e. the body member **14**, the head member **18** and the base member **20**, is made of a weather-proof, highly insulated material, such as polyethylene resin or bio-based plastic, including biodegradable bioplastics. Bioplastics or organic plastics are a form of plastics derived from renewable biomass sources, such as vegetable oil, corn starch, pea starch, or microbiota rather than fossil-fuel plastics which are derived from petroleum. Some, but not all, bioplastics are biodegradable.

The substantially annular body member **14** is formed as a hollow single-piece part made for example by rotational molding. Preferably, as illustrated in FIGS. **5-7**, the body member **14** includes a number, such as four, ring portions $\mathbf{22}_1$, $\mathbf{22}_2$, $\mathbf{22}_3$ and $\mathbf{22}_4$ disposed in a stacked relationship (i.e., one on top of the other) along the central axis **11**. Each ring is a surface of revolution generated by revolving a semi-circle in three dimensional space about the central axis **11** coplanar with the semi-circle. The hollow body member **14** is axially open at both the lower end portion **15** and the upper end portion **16**, and defines an internal cavity **24** delimited by a circular lower opening **25** at the lower end portion **15** and a circular upper opening **26** at the upper end portion **16** of the body member **14**. As shown in FIGS. **6** and **7**, the lower and upper openings **25** and **26** are coaxial with each other and with the central axis **11**. The upper opening **26** provides an access to the internal cavity **13** in the body member **14**. The body member **14** of the hollow casing **12**, illustrated in detail in FIGS. **1-4**, is, preferably, in the form of a stylized body of the earthworm.

The body member **14** further includes a hinge support **28** formed integrally therewith and provided at the upper opening **26** of the upper end portion **16** of the body member **14**. Specifically, as shown in detail in FIGS. **5-7**, the hinge support **28** is formed on top of the upper ring portion $\mathbf{22}_4$ of the body member **14** so as to extend above the upper opening **26** of the body member **14**. The hinge support **28** is provided with a pin hole **29** therethrough.

The body member **14** further includes a support portion **30** fixed to the body member **14** below the lower ring portion $\mathbf{22}_1$. The support portion **30** includes a substantially cylindrical flange skirt **32** connecting the body member **14** with the base member **20**. As illustrated in detail in FIGS. **5-7**, the cylindrical flange skirt **32** is coaxial with the central axis **11** and extends below the lower ring portion $\mathbf{22}_1$ of the body member **14**. The flange skirt **32** is provided with a pair of opposite windows (or cut-outs) **33** formed in a cylindrical surface thereof. The support portion **30** further includes a pair of opposite, inwardly projecting pins **34** facing the cut-outs **33** in the cylindrical flange skirt **32**. It will be appreciated that while the first exemplary embodiment of the present invention discloses the support portion **30** with two pins **34**, any appropriate number of pins **34**, such as one, three, etc., is within the scope of the present invention.

The head member **18** of the hollow casing **12**, illustrated in detail in FIGS. **8-11**, is, preferably, in the form of a stylized head of the earthworm, and provided to function as a hinged lid of the vermicomposting device **10** providing access to composting material in the casing **12**. The head member **18** is formed as a hollow single-piece part made, for example, by plastic molding. The head member **18** includes a support portion **36** formed integrally therewith and provided with at least one, but preferably two coaxial pin holes **37** therethrough. In an assembled condition, the pin hole **29** of the hinge support **28** of the body member **14** is coaxial with the pin holes **37** of the support portion **36** of the head member **18** so that the head member **18** is pivotally connected to the body member **14** of the casing **12** of the vermicomposting device **10** with a hinge pin **38** extending through the pin hole **29** of the body member **14** and the pin holes **37** of the head member **18**. The head member **18** functions as a closure (or lid) of the internal cavity **13** defined by the hollow body member **14**. The head member **18** is movable between a closed position (shown in FIG. **2**A) and an open position (shown in FIG. **2**B) providing access to the internal cavity **13** in the body member **14** and to the composting material therein.

As illustrated in FIG. **9**C, the head member **18** of the vermicomposting device **10** includes a plurality of aeration holes **35** for providing air (oxygen) to compost micro-organisms. Preferably, the aeration holes **35** are provided in the back section of the head member **18** and possibly on a bottom section, and can be done by drilling or integral molding and covered with a mesh screen.

The base member **20** of the hollow casing **12**, illustrated in detail in FIGS. **12-14**, is, preferably, in the form of a stylized tail-end portion of the earthworm, and provided to function as a base of the vermicomposting device **10**. The base member **20** includes a support portion **40** and a drip bucket **42** mounted to the support portion **40** and defining a container disposed under the body member **14** coaxially therewith. Preferably, according to the first exemplary embodiment of the present invention, the drip bucket **42** is integral with the support portion **40** of the base member **20**. Further preferably, the base

member **20** including the support portion **40** and the drip bucket **42** is formed as a single-piece part made, for example, by plastic molding.

As further illustrated in FIGS. **12**, **13**B and **14**, the drip bucket **42** is mounted to the support portion **40** so as to extend both into and out of the support portion **40** of the base member **20**. The drip bucket **42** is in the form of an open top bucket that includes a circular solid (i.e., without any holes therein) bottom wall **44** surrounded by an annular side wall **46** upwardly extending from said bottom wall toward the body member **14** so as to form a cavity **45**. The annular side wall **46** of the drip bucket **42** forms an opening **48** facing the body member **14**. Preferably, the annular side wall **46** is substantially conical in shape. Alternatively, the annular side wall **46** can be substantially cylindrical. The opening **48** of the drip bucket **42** is delimited by a substantially annular top surface **47** of the drip bucket **42**. Preferably, the drip bucket **42** is further provided with an annular support surface **49** axially spaced from and parallel to the top surface **47** of the drip bucket **42**. Both the top surface **47** and the support surface **49** of the drip bucket **42** are coaxial and orthogonal to the central axis **11**.

As further illustrated in detail in FIGS. **12-13**B, the drip bucket **42** of the base member **20** includes with a pair of opposite L-shaped grooves **43** provided for receiving the inwardly extending pins **34** formed on the support portion **30** of the body member **14** of the casing **10**. Moreover, the base member **20** is provided with an annular channel **41** disposed between the support portion **40** and an outer peripheral surface of the drip bucket **42**. The annular channel **41** is sized to be complementary to the cylindrical flange skirt **32** of the support portion **30** of the body member **14**.

The base member **20** is sized and shaped to receive the support portion **30** of the body member **14** in a telescoping fashion. As further illustrated in detail in FIGS. **12-13**B, the outer peripheral surface of the drip bucket **42** (i.e., outside the cavity **45**) is provided with a pair of opposite L-shaped grooves **43** provided for receiving the inwardly extending pins **34** formed on the support portion **30** of the body member **14** of the casing **10**. The number of grooves **43**, which in this embodiment is two, obviously corresponds to the number of the pins **34** on the support portion **30** of the body member **14**. The grooves **43** are sized to snugly receive the pins **34**. More particularly, as best seen in FIGS. **12** and **13**B, each of L-shaped grooves **43** includes an open end **43***a* and a closed end **43***b*. The open end **43***a* is continuous with the top surface **47** of the drip bucket **42** and extends generally axially in the direction generally parallel to the central axis **11** of the vermicomposting device **10**. The closed end **43***b* is a closed-ended groove that extends a distance circumferentially (transversely) from the open end **43***a*, thereby forming an L-shaped groove.

In operation, during the assembly of the casing **12** of the vermicomposting device **10** according to the first exemplary embodiment of the present invention, the body member **14** is positioned around the annular top surface **47** of the drip bucket **42** of the base member **20** so that the cylindrical flange skirt **32** of the support portion **30** of the body member **14** is inserted into the annular channel **41** and the pins **34** are aligned with the open ends **43***a* of the L-shaped grooves **43**. After the pins **34** are aligned, the body member **14** is advanced further over the base member **20** so that the pins **34** are inserted into the open ends **43***a* of the L-shaped grooves until the pins **34** abut the end of the open ends **43***a*. At this point, the body member **14** is rotated so that the pins **34** slide to the closed ends **43***b* of the L-shaped grooves **43**. Accordingly, the body member **14** and the base member **20** are cooperatively configured to form a twist-lock coupling therebetween.

The vermicomposting device **10** further comprises one or more, such as four according to the preferred embodiment of the present invention, of composting trays $\mathbf{50}_1$-$\mathbf{50}_4$ removably disposed within the internal cavity **24** in the body member **14** of the casing **12** in a stacked relationship (i.e., one on top of the other) in the direction of the central axis **11**, as illustrated in FIGS. **3** and **4**. These composting trays $\mathbf{50}_1$-$\mathbf{50}_4$ are substantially structurally identical in this embodiment. In view of their similarity and in the interest of simplicity, the following discussion will use a reference numeral without a letter to designate an entire group of substantially identical composting trays. For example, the reference numeral **50** will be used when generically referring to the composting trays $\mathbf{50}_1$, $\mathbf{50}_2$, $\mathbf{50}_3$ and $\mathbf{50}_4$ rather than reciting all four reference numerals.

As shown in detail in FIGS. **15-17**, each of the composting trays **50** is in the form of an open top, substantially cylindrical tray that includes a circular perforated bottom wall **52** surrounded by an annular, substantially conical side wall **54** upwardly extending from the perforated bottom wall **52** substantially along the central axis **11** in the direction toward the head member **18** so as to form a cavity **56** adapted to contain a composting material and/or ready to use compost and worms. Each of the composting trays **50** is provided with a plurality of apertures **53** at the perforated bottom wall **52** thereof. The apertures **53** in each of the composting trays **50** allow the worms to move (migrate) between the composting trays **50** disposed inside the casing **12** of the vermicomposting device **10**. Furthermore, each of the composting trays **50** has an annular rim **58** formed at an axially distal end of the side wall **54** and defining an opening of the composting tray **50**. Each of the composting trays **50** also has a number, such as six, of axially extending support ribs **60** provided on an outer peripheral surface of the side wall **54** and a number of seats **62** provided on an inner peripheral surface of the side wall **54**. Alternatively, the inner peripheral surface of the side wall **54** of the composting tray **50** may be provided with an annular seat coaxial with the central axis **11**, instead of the number of seats **62**. Preferably, each of the composting trays **50** is formed as a single-piece part made for example by plastic molding. Further preferably, the composting trays **50** are made of a weather-proof, highly insulated material, such as polyethylene resin or bio-based plastic, including biodegradable bioplastics.

As illustrated in FIG. **3**, the bottom (lower) one of the composting trays **50** (the composting tray $\mathbf{50}_1$) is supported by the drip bucket **42** of the base member **20**. Specifically, the support ribs **60** of the lower composting tray $\mathbf{50}_1$ are supported by the top surface **47** of the drip bucket **42** of the base member **20**. Alternatively, the lower composting tray $\mathbf{50}_1$ is supported by both the top surface **47** of the drip bucket **42** supporting the support ribs **60** and by the support surface **49** of the drip bucket **42** supporting the perforated bottom wall **52** of the lower composting tray $\mathbf{50}_1$. As further illustrated in FIG. **3**, the next composting tray $\mathbf{50}_2$ is supported by the lower composting tray $\mathbf{50}_1$ so that the support ribs **60** of the composting tray $\mathbf{50}_2$ are supported by the annular rim **58** of the lower composting tray $\mathbf{50}_1$ so that the perforated bottom wall **52** of the composting tray $\mathbf{50}_2$ is axially spaced from the perforated bottom wall **52** of the lower composting tray $\mathbf{50}_1$ in the direction of the central axis **11**. The composting trays $\mathbf{50}_3$ and $\mathbf{50}_4$ are similarly supported by the composting trays $\mathbf{50}_2$ and $\mathbf{50}_3$, respectively.

As further illustrated in FIGS. **3** and **4**, each of the composting trays **50** is provided with a grid member **64** removably disposed within one of the composting trays **50**. As shown in detail in FIGS. **18-20**, the grid member **64** includes a circular perforated bottom wall **66** surrounded by a short annular

sidewall **68** upwardly extending from the perforated bottom wall **66** in the direction toward the head member **18** so as to form a cavity adapted to contain a composting material and/or ready to use compost and worms. Each of the grid members **64** is provided with a plurality of apertures **67** at the perforated bottom wall **66** thereof. The apertures **67** in each of the grid members **64** allow the worms to move (migrate) between the grid members **64** and the composting trays **50** disposed inside the casing **12** of the vermicomposting device **10**. Furthermore, each of the grid members **64** has an annular rim **70** formed at an axially distal end of the sidewall **68** and defining an opening of the grid member **64**. Preferably, each of the grid members **64** is formed as a single-piece part made for example by plastic molding. Further preferably, the grid members **64** are made of a weather-proof, highly insulated material, such as polyethylene resin or bio-based plastic, including biodegradable bioplastics.

As also illustrated in FIG. **3**, the grid member **64** is disposed entirely within one of the composting trays **50** so that the perforated bottom wall **66** of the grid member **64** is axially spaced from the perforated bottom wall **52** of the composting tray **50** within which the grid member **64** is disposed. Specifically, the rim **70** of the grid member **64** is supported by the seats **62** provided on the inner peripheral surface of the side wall **54** of the composting tray **50** in an axially spaced relationship relative to the bottom wall **52** of the composting tray **50**.

To add composting material into the top composting tray $\mathbf{50}_4$, a user opens the upper opening **26** of the body member **14** by pivotally rotating the head member **18** upwardly away from the upper end portion **16** of the body member **14** and places the composting material **26** on the perforated bottom wall **52** of the top composting tray $\mathbf{50}_4$, then pivotally closes the head member **18**.

The drip bucket **42** is disposed under the composting trays **50** and is provided to receive and collect any liquid byproduct from the vermicomposting process, commonly known as compost tea or "worm tea", that drains down into the drip bucket **42** through the apertures **53** in the perforated bottom walls **52** of the composting trays **50** and the apertures **67** in the perforated bottom walls **66** of the grid members **64**. The sidewall **46** of the drip bucket **42** is side wall **46** is substantially conical in shape such that any liquid byproduct drains down generally in one direction toward bottom wall **44** of the drip bucket **42**.

The most common worms used in vermicomposting devices, redworms (*Eisenia foetida, Eisenia andrei*, and *Lumbricus rubellus*), feed most rapidly at temperatures of 59 to 77° F. (15-25° C.). They can survive at 50° F. (10° C.). Temperatures above 86° F. (30° C.) may harm them. This temperature range means that indoor vermicomposting with redworms is suitable in all but tropical climates. (Other worms like *Perionyx excavatus* are suitable for warmer climates.) If a vermicomposting device is kept outside, it should be placed in a sheltered position away from direct sunlight and insulated against frost in winter. It is necessary to monitor the temperatures of vermicomposting devices (which can have high heat-retaining properties), as the feedstock used can compost, heating up the vermicomposting devices as they decay and killing the worms.

FIGS. **21-33** illustrate a vermicomposting device **110** according to a second exemplary embodiment of the present invention. In FIGS. **21-33**, components, which are unchanged from, or function in the same way as in the first exemplary embodiment of the present invention are designated by the same reference numerals as in FIGS. **1-20**.

As shown in FIGS. **21-24** and similarly to the vermicomposting device **10** according to the first exemplary embodiment of the present invention, the vermicomposting device **110** comprises a hollow casing **112** extending along a central axis **111** and defining an internal cavity **113** therein. The casing **112** includes a substantially annular, hollow body member **114**, a head member **18** and a base member **120**. The body member **114** has a lower end portion **115** and an upper end portion **116**. Further according to the present invention, the head member **18** is pivotally mounted to the upper end portion **116** of the body member **114**, while the base member **120** is removably attached to the lower end portion **115** of the body member **114** for supporting the vermicomposting device **110** in an upright, vertical position on a support surface, such as ground of a backyard.

The casing **112** of the vermicomposting device **110** according to the second exemplary embodiment of the present invention is made in the shape of an animal including a worm, a bug, a reptile, a bird or a mammal. Preferably, as illustrated in FIGS. **21-24**, the casing **112** of the vermicomposting device **110** is made in the shape of a stylized earthworm in an upright position.

Each part of the casing **112**, i.e. the body member **114**, the head member **18** and the base member **120**, is made of a weather-proof, highly insulated material, such as polyethylene resin or bio-based plastic, including biodegradable bioplastics.

The substantially annular body member **114** is formed as a hollow single-piece part made for example by rotational molding. Preferably, as illustrated in FIGS. **25-27**, the body member **114** includes a number, such as four, ring portions $\mathbf{122}_1$, $\mathbf{122}_2$, $\mathbf{122}_3$ and $\mathbf{122}_4$ disposed in a stacked relationship (i.e., one on top of the other) along the central axis **111**. Each ring is a surface of revolution generated by revolving a semi-circle in three dimensional space about the central axis **111** coplanar with the semi-circle. The hollow body member **114** is axially open at both the lower end portion **115** and the upper end portion **116**, and defines an internal cavity **124** delimited by a circular lower opening **125** at the lower end portion **115** and a circular upper opening **126** at the upper end portion **116** of the body member **114**. As shown in FIGS. **26** and **27**, the lower and upper openings **125** and **126** are coaxial with each other and with the central axis **111**. Disposed within the body member **114** are the composting trays **50** with the grid members **64**.

The body member **114** further includes a hinge support **28** formed integrally therewith and provided at the upper opening **126** of the upper end portion **116** of the body member **114**. Specifically, as shown in detail in FIGS. **25-27**, the hinge support **28** is formed on top of the upper ring portion $\mathbf{122}_4$ of the body member **114** so as to extend above the upper opening **126** of the body member **114**. The hinge support **28** is provided with a pin hole **29** therethrough.

The body member **114** further includes a support portion **130** fixed to the body member **114** below the lower ring portion $\mathbf{122}_1$. The support portion **130** includes a substantially cylindrical flange skirt **132** connecting the body member **114** with the base member **120**. As illustrated in detail in FIGS. **25-27**, the cylindrical flange skirt **132** is coaxial with the central axis **111** and extends below the lower ring portion $\mathbf{122}_1$ of the body member **114**. The flange skirt **132** is provided with at least one straight axial groove **134** formed in a cylindrical surface thereof. As illustrated in detail in FIG. **26**, the axial groove **134** extends vertically and substantially parallel to the central axis **111**. It will be appreciated that while the second exemplary embodiment of the present invention discloses the support portion **130** with two opposite axial

groove **134**, any appropriate number of the axial grooves **134**, such as one, two, three, etc., is within the scope of the present invention.

The head member **18** of the hollow casing **112** according to the second exemplary embodiment of the present invention is generally identical to the head member **18** of the hollow casing **12** according to the first exemplary embodiment of the present invention illustrated in detail in FIGS. **8-11**. The head member **18** is pivotally connected to the body member **114** of the casing **112** of the vermicomposting device **110** with a hinge pin **38** (shown in FIG. **24**) extending through the pin hole **29** of the body member **114** and the pin holes **37** of the head member **18** shown in FIGS. **9**B, **10** and **11**.

The base member **120** of the hollow casing **112**, illustrated in detail in FIGS. **28-30**, is, preferably, in the form of a stylized tail-end portion of the earthworm, and provided to function as a base of the vermicomposting device **110**. The base member **120** includes a hollow support portion **140** defining an open top cavity **141** formed by a substantially circular bottom wall **150** surrounded by a substantially cylindrical inner peripheral sidewall **152** upwardly extending from the bottom wall **150** substantially along the central axis **111** in the direction toward the head member **18** so as to form the cavity **141**.

As illustrated in detail in FIGS. **24**, **28** and **29**A, the support portion **140** of the base member **120** is provided with two opposite straight axial ridges **154** formed on the cylindrical inner peripheral sidewall **152** thereof. The axial ridges **154** extend vertically and substantially parallel to the central axis **111**. It will be appreciated that the number of axial ridges **154** of the base member **120** corresponds to the number of the axial grooves **134** in the support portion **130** of the body member **114**. Moreover, each of the axial ridges **154** is geometrically complementary to the corresponding axial groove **134**. Preferably, the base member **120** including the support portion **140** is formed as a single-piece part made, for example, by plastic molding.

In operation, during the assembly of the casing **112** of the vermicomposting device **110** according to the second exemplary embodiment of the present invention, the body member **114** is positioned above the base member **120** so that the cylindrical flange skirt **132** of the support portion **130** of the body member **114** is inserted into the cavity **141** and the axial grooves **134** are aligned with the axial ridges **154** of the base member **120**. After the axial grooves **134** are aligned, the body member **114** is advanced further over the base member **120** so that the axial ridges **154** are inserted into the axial grooves **134** of the body member **114** until the flange skirt **132** of the support portion **130** abuts the bottom wall **150** of the base member **120**. Accordingly, the body member **114** and the base member **120** are cooperatively configured to form a non-rotatable coupling therebetween.

The vermicomposting device **110** further comprises a drip bucket **142** shown in detail in FIGS. **31-33**. As illustrated in FIGS. **23** and **24**, the drip bucket **142** is removably disposed in the cavity **141** of the support portion **140** and defines a container disposed under the composting trays **50**, in turn located within the body member **114** coaxially therewith. According to the second exemplary embodiment of the present invention, the drip bucket **142** is formed separate from the support portion **140** of the base member **120**. Preferably, the drip bucket **142** is formed as a single-piece part made, for example, by plastic molding. Further preferably, the drip bucket **142** is made of a weather-proof, highly insulated material, such as polyethylene resin or bio-based plastic, including biodegradable bioplastics.

As further illustrated in FIG. **23**, the drip bucket **142** is removably mounted to the support portion **140** so as to extend both into and out of the support portion **140** of the base member **120**. The drip bucket **142** is in the form of an open top bucket defining an open top cavity **145** formed by a circular solid (i.e., without any holes therein) bottom wall **144** surrounded by an annular side wall **146** upwardly extending from the bottom wall **144** in the direction toward the body member **114** substantially along the central axis **111** so as to form the cavity **145**. The annular side wall **146** of the drip bucket **142** forms an opening **148** facing the body member **114**. Preferably, the annular side wall **146** is substantially conical in shape. Alternatively, the annular side wall **146** can be substantially cylindrical. The opening **148** of the drip bucket **142** is delimited by a substantially annular top surface **147** of the drip bucket **142**. Preferably, the drip bucket **142** is further provided with an annular support surface **149** axially spaced from and parallel to the top surface **147** of the drip bucket **142**. Both the top surface **147** and the support surface **149** of the drip bucket **142** are coaxial and orthogonal to the central axis **111**.

As illustrated in FIG. **23**, the bottom (lower) one of the composting trays **50** (the composting tray $\mathbf{50}_1$) is supported by the drip bucket **142**. Specifically, the support ribs **60** of the lower composting tray $\mathbf{50}_1$ are supported by the top surface **147** of the drip bucket **142**. Alternatively, the lower composting tray $\mathbf{50}_1$ is supported by both the top surface **147** of the drip bucket **142** supporting the support ribs **60** and by the support surface **149** of the drip bucket **142** supporting the perforated bottom wall **52** of the lower composting tray $\mathbf{50}_1$. As further illustrated in FIG. **23**, the next composting tray $\mathbf{50}_2$ is supported by the lower composting tray $\mathbf{50}_1$ so that the support ribs **60** of the composting tray $\mathbf{50}_2$ are supported by the annular rim **58** of the lower composting tray $\mathbf{50}_1$ so that the perforated bottom wall **52** of the composting tray $\mathbf{50}_2$ is axially spaced from the perforated bottom wall **52** of the lower composting tray $\mathbf{50}_1$ in the direction of the central axis **11**. The composting trays $\mathbf{50}_3$ and $\mathbf{50}_4$ are similarly supported by the composting trays $\mathbf{50}_2$ and $\mathbf{50}_3$, respectively. In other words, the composting trays **50** are stacked on top of each other and the drip bucket **142** disposed beneath the composting trays **50**. As shown in FIGS. **23** and **24**, the composting trays **50** and the drip bucket **142** are vertically aligned in the direction of the central axis **111** so that the composting trays **50** are stacked on top of the drip bucket **142**. In turn, the drip bucket **142** is stacked on top of the base member **120**.

As further illustrated in detail in FIGS. **32**A and **33**, the drip bucket **142** has a substantially circular end wall **141** substantially perpendicular to the central axis **111** and disposed directly on (i.e., in contact with) the bottom wall **150** of the base member **120** inside the cavity **141** thereof. Moreover, the end wall **141** of the drip bucket **142** is provided with a depression (or recess, indentation) **143***a* complimentary with a projection **150***a* formed on the bottom wall **150** of the base member **120**. As shown in FIGS. **29**A and **32**A, the projection **150***a* and the indentation **143***a* are irregular in a plane perpendicular to the central axis **111**. Thus, in an assembled condition of the vermicomposting device **110**, the irregular projection **150***a* on the bottom wall **150** of the base member **120** is received in the irregular indentation **143***a* in the end wall **141** of the drip bucket **142** only when the indentation **143***a* and the projection **150***a* are aligned in the direction of the central axis **111**. Accordingly, the base member **120** and the drip bucket **142** are cooperatively configured to form a non-rotatable coupling therebetween.

The foregoing description of the preferred embodiments of the present invention has been presented for the purpose of

illustration in accordance with the provisions of the Patent Statutes. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments disclosed hereinabove were chosen in order to best illustrate the principles of the present invention and its practical application to thereby enable those of ordinary skill in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated, as long as the principles described herein are followed. Thus, changes can be made in the above-described invention without departing from the intent and scope thereof. It is also intended that the scope of the present invention be defined by the claims appended thereto.

What is claimed is:

1. A vermicomposting device for vermicomposting organic material, comprising:

a casing extending along a central axis and including a substantially annular hollow body member defining an internal cavity and having a lower end portion and an upper end portion, a head member mounted to said upper end portion of said body member and a base member removably attached to said lower end portion of said body member for supporting said vermicomposting apparatus on a support surface; and

a plurality of composting trays removably disposed within said internal cavity in a stacked relationship in the direction of said central axis, each of said composting trays being in the form of an open top tray that includes a circular perforated bottom wall surrounded by an annular side wall upwardly extending from said perforated bottom wall so as to form a cavity adapted to contain a composting material and/or ready to use compost and worms;

said base member including a support portion and a drip bucket mounted to said support portion and defining a container disposed under said composting trays to receive and collect any liquid byproduct from the vermicomposting process drained down into said drip bucket through said perforated bottom wall of said composting trays;

said drip bucket being in the form of an open top bucket that includes a circular solid bottom wall surrounded by an annular side wall upwardly extending from said bottom wall toward said composting trays;

said head member movable relative to said body member so as to provide an access to said internal cavity of said body member.

2. The vermicomposting device as defined in claim **1**, further comprising plurality of grid members, each of said grid members removably disposed within one of said plurality of composting trays.

3. The vermicomposting device as defined in claim **2**, wherein each of said grid members includes a circular perforated bottom wall surrounded by a short annular sidewall upwardly extending from said perforated bottom wall in the direction of said central axis.

4. The vermicomposting device as defined in claim **3**, wherein each of said composting trays including a number of seats provided on an inner peripheral surface of said side wall thereof; and wherein each of said grid members further includes a rim supported by said seats of said composting trays so that said perforated bottom wall of said grid member is axially spaced from said perforated bottom wall of said composting tray within which said grid member is disposed.

5. The vermicomposting device as defined in claim **1**, wherein said head member is pivotally mounted to said upper end portion of said body member so as to provide said access to said internal cavity of said body member.

6. The vermicomposting device as defined in claim **1**, wherein said drip bucket is integral with said support portion of said base member.

7. The vermicomposting device as defined in claim **6**, wherein said drip bucket is formed integrally with said support portion as a single-piece part.

8. The vermicomposting device as defined in claim **1**, wherein said drip bucket is separate from said support portion and removably mounted therein.

9. The vermicomposting device as defined in claim **1**, wherein each of said plurality of said composting trays includes a perforated plate removably mounted in each of said composting trays so that said perforated plate is axially spaced from said perforated bottom wall of each of said composting trays in the direction of said central axis.

10. The vermicomposting device as defined in claim **1**, wherein said body member includes a support portion provided with a substantially cylindrical flange skirt connecting said body member with said base member.

11. The vermicomposting device as defined in claim **10**, wherein said support portion provided with an inwardly projecting pin; and wherein said base member is provided with an L-shaped groove configured to receive said inwardly extending pin so as to form a twist-lock coupling between said body member and said base member.

12. The vermicomposting device as defined in claim **10**, wherein said flange skirt of said support portion provided with a straight axial groove formed in a cylindrical surface of said flange skirt and extending substantially parallel to said central axis; and wherein said support portion of said base member is provided with a straight axial ridge complementary to said straight axial groove and formed on a cylindrical inner peripheral sidewall thereof and extending substantially parallel to said central axis.

13. The vermicomposting device as defined in claim **1**, wherein said body member and said base member are cooperatively configured to form a twist-lock coupling therebetween.

14. The vermicomposting device as defined in claim **13**, wherein said body member includes a support portion provided with an inwardly projecting pin; and wherein said base member is provided with an L-shaped groove configured to receive said inwardly extending pin so as to form said twist-lock coupling between said body member and said base member.

15. The vermicomposting device as defined in claim **1**, further comprising plurality of aeration holes in said casing, said aeration holes fluidly connecting said internal cavity in said body member with atmospheric air outside said casing.

16. The vermicomposting device as defined in claim **15**, wherein said aeration holes are provided in said head member of said casing.

17. The vermicomposting device as defined in claim **1**, wherein each part of said casing including said body member, said head member and said base member is made of a weatherproof bio-based plastic material.

18. The vermicomposting device as defined in claim **17**, wherein said bio-based plastic material is biodegradable bioplastic material.

19. The vermicomposting device as defined in claim **1**, wherein said casing is made in the shape of an animal including one of a worm, a bug, a reptile, a bird and a mammal.

20. The vermicomposting device as defined in claim **19**, wherein said casing is made in the shape of a stylized earthworm in an upright position.

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